PRECIPITATION.

The average monthly precipitation for California for May is as follows:

Year.	Mean.	Departure.	Year.	Mean.	Departure.
	Inches.	*Inches.*		*Inches.*	*Inches.*
1897	0.18	−1.16	1905	2.18	+.84
1898	1.56	+0.22	1906	3.19	+1.85
1899	0.73	−0.61	1907	.57	−0.77
1900	1.39	+0.05	1908	1.63	+.29
1901	1.03	−0.31	1909	.23	−1.11
1902	0.84	−0.50	1910	.18	−1.16
1903	0.14	−1.20	1911	.72	−0.62
1904	0.22	−1.12			

The greatest 24-hour precipitation was 1.65 inches at Weitchpec, and the greatest monthly amount was 6.78 inches, also at Weitchpec. There was practically no rain in the southern counties.

SUNSHINE.

The following table gives the total hours of sunshine and percentages of possible:

Stations.	Hours.	Per cent of possible.	Stations.	Hours.	Per cent of possible.
Eureka	187	42	Sacramento	288	66
Fresno	394	90	San Diego	.....	.....
Los Angeles	304	70	San Francisco	257	58
Mount Tamalpais	309	70	San Jose	343	78
Red Bluff	325	73	San Luis Obispo	259	59

There was less sunshine at the coast stations than usually occurs in May. At San Francisco, for example, the percentage was lower than in any year since 1891.

LOCAL STORMS.

May 23, a windstorm early in the morning did considerable damage to fruit and vegetation in the San Joaquin Valley. At Stockton signs were blown down and it became necessary to shut off the electric current used for lighting. A fire wall on San Joaquin Street was blown down and two persons slightly injured.

In Sacramento the wind reached a velocity of 40 miles an hour from the south, but aside from dust carried by the high wind and the blowing down of signs not properly fastened there was no damage done.

NOTES ON THE RIVERS OF THE SACRAMENTO AND SAN JOAQUIN WATERSHEDS FOR MAY, 1911.

By N. R. TAYLOR, Local Forecaster.

The Sacramento watershed.—The rivers of this watershed were exceptionally high during the entire month, with but little difference between the highest and lowest stages.

At the close of April the snow fields of the high Sierra were unusually extensive, and well-packed snow ranging in depth from 5 to over 10 feet was general above the 5,500-foot level. The slow melting of this snow during May caused a continuation of high stages in all of the larger streams, but kept the smaller mountain watercourses below the danger point. No freshets were reported from any section of the Sacramento Valley during the month.

In the Sacramento River above Redding there was little departure from the stages usually maintained during the month in question; but from Red Bluff to the mouth of the river this stream averaged from 1 foot to over 2 feet above the normal for the month. At Red Bluff, Colusa, Knights Landing, and Sacramento City the river averaged 1.2, 2.2, 2.1, and 1.7 feet, respectively, above the normal stages, and at all these points the river was higher than during any May since that of 1907.

The San Joaquin watershed.—All streams in this watershed carried more than the usual amount of water. At Firebaugh, on the San Joaquin, the river averaged higher than for any May since that of 1907, and at Melones, on the Stanislaus, the average stage of the river was the highest ever known for any month since the records have been kept.

PROTECTION AGAINST FROST—FROST CANDLES.

By A. G. MCADIE.

In an effort to improve upon present frost-fighting apparatus there has been devised at the San Francisco Weather Bureau office an inexpensive frost candle. It has also been called a frost cartridge, because of a fancied resemblance to a large cartridge. The device consists of two portions, the lower or cartridge proper, and an upper metallic screen or cover. The cartridge consists of a cardboard or stiff paper tube of suitable dimensions filled with combustible material. In actual practice, mailing tubes, about 12 inches long and 1½ inches in diameter, are used for the smaller size. For the larger size the dimensions may be doubled. The tube is filled with cotton waste or other suitable wicking and either crude oil or distillate. A stopper is provided for the lower end, but with a little experience the cotton waste may be so packed as to prevent any leakage of oil. A projecting end of the cotton waste serves as a ready means of lighting.

About 6 inches above the cartridge is a metallic cover, which is simply a sheet of thin metal, iron or tin, 20 inches long and 14 inches wide, cut along diagonal lines at each corner about 3½ inches. The ends are then bent downward making an inverted pan, the sides of which flare outward. The purpose of the inverted pan is to catch and hold a certain amount of the heated air rising from the burning end of the cartridge. It also serves to catch and hold the soot particles as they rise in the smoke. In burning crude oil the carbon is very noticeable and some means is necessary to prevent its settling on the fruit. The cover becoming heated will retain its heat longer than a screen of different shape, owing to its box-like character. Moreover the top surface, metallic, will radiate heat upward to the fruit a few inches above. This heat is preferable to the convectional heat from the naked flame, as it will not scorch or singe the boughs, leaves, or fruit.

The cartridge is held in place by a series of small loops made of wire, fastened to the edge of the cover. Three of these holding loops are sufficient. The whole device, cartridge and cover, is hung under the tree, suspended from a bough by one or more wire hooks. The distance from the bough can be varied at will from a few inches to several feet. Preferably about 4 inches below the bough will answer.

The cartridges may be filled during the afternoon hours and set in their cradles. When the temperature falls to the danger point a man can pass through the orchard and with a small, flaming torch rapidly light the upper ends of the cartridges, which should burn gradually and

completely, the entire cartridge being consumed. Tests made at San Francisco show that the cartridges will burn for about three hours.

One great advantage of the device is that the heat can be applied where most needed, namely, as close to the fruit as possible, and there is no heat wasted in warming up all out-of-doors. The method is cleaner than any ordinary uncovered system using crude oil, as the objectionable soot particles are in large measure deposited on the inner side of the cover. If the outer surface becomes black no harm is done, as, other things being equal, a black surface radiates heat better than other surfaces.

The covers remain in place until danger of fros is passed. They can then be stacked so as to occupy but little space.

FIGHTING FROST.

By Mr. J. E. ADAMSON, of Pomona, Cal.

The possibility of saving fruit crops from frost damage is simply a question of energy intelligently applied.

In our experiments in this work it was soon realized that success depends largely on two things, viz, early lighting to blanket the earth and conserve the latent heat, and the subdivision of the fuel into many fires to offset the fact that the horizontal radiation from fires in the open is very slight.

In regard to conservation, we have found that on nights of low relative humidity the earth will begin to crust over at about 28° F., therefore it was decided to assume 30° F. as a desirable point to begin firing. The wisdom of this has been fully proven this past season by the ease with which temperatures were maintained, as compared with other seasons when we waited longer before lighting. My own practice was to get out at 30° F. and light fires to windward of about each 15 rows of trees, and then watch for any tendency to drop to lower temperatures under the blanket of smoke, lighting additional fires to prevent any drop below 28° F.

My grove lies in a very difficult position for easy work. Being sheltered by a low range of hills, we are sometimes in a dead calm while districts not far distant are under the influence of a strong desert wind. Then, as the rows of trees are at a considerable angle to the prevailing drift on frosty nights, I find it necessary to light the north and east sides to secure a good covering of smoke.

Comparing the fall of temperature under the smudge with that in the open to windward, it would seem that the smudge delayed the fall at least two hours, after which it will be found necessary to light more fires to hold the temperature. I had no trouble holding 30° in the fire zone, while it fell to 22° at a point 200 feet to windward, with 900 fires to 1,000 trees.

The fact that it was necessary to go so far to windward to find the minimum temperature accounts for the fact that so many investigations seem to show only 2° or 3° gain of temperature in the fire zone. This is easily accounted for by the increase in air circulation, caused by the heat rising from the fires, producing a gentle but effective air mixture.

The question of subdivision of fires has been provided for by using 1 gallon of oil for seven to eight hours burning. The value of the subdivision will be seen from a simple comparison. If we have 100 trees planted 20 feet apart we would have a square 200 feet on each side. Now, if 100 gallons of oil were burned in one fire there would be intense heat close to the fire, but as the radiation is very slight horizontally, there would be found very little effect beyond 30 feet, while if the oil were divided into 100 fires (one to each tree) there would be no great heat at any one point, but it would be distributed over the whole tract.

One desirable point in firing devices is a regular rate of burning from start to finish, a condition not met in any burner which has come to the notice of the writer. To get the desired result it is easily seen that the oil must be at a uniform distance from the rim of the container.

Working along this line, we conceived the idea of using a paper container and, as finally put into practice in the season of 1909–10, a heavy paper bag, known to the grocery trade as "No. 4 sugar," was used. Filled with crude oil the bag was fired by dropping in a small quantity of burning distillate. The bag and contents burned down very regular and gave excellent results.

Several thousand were used that season, the cost being $3.50 per 1,000; but their use was discontinued for the reason that it was found difficult to get a bag without a leak in the seam where the bag is folded.

The work of the past season was carried on with different types of metal pots, using slop distillate. The frost periods this season were not severe or protracted, but just enough came to prove the value of the work.

I have lemon trees full of fruit that went through the frost as small fruit, while groves in the immediate neighborhood have no small fruit.

Summing up the results of our work, I would say that the most important part is not the saving of the fruit or trees this season, but the feeling of satisfaction coming from the fact that we realize the fight can be carried out along definite lines. The principles involved are three, viz, blanketing to minimize radiation; heating to offset radiation; and air mixing, caused by the increased circulation due to the heated air rising.